Hybridization

Predict versus Real

- Valence electrons involved in bonding
- Example: CH_4
  - H bonded into 2s and 2p orbitals of C—3 H would be 90° to C and 1 H would be 135°
  - All H really 109.5° to C
- Orbitals are mixing to form hybrid orbitals

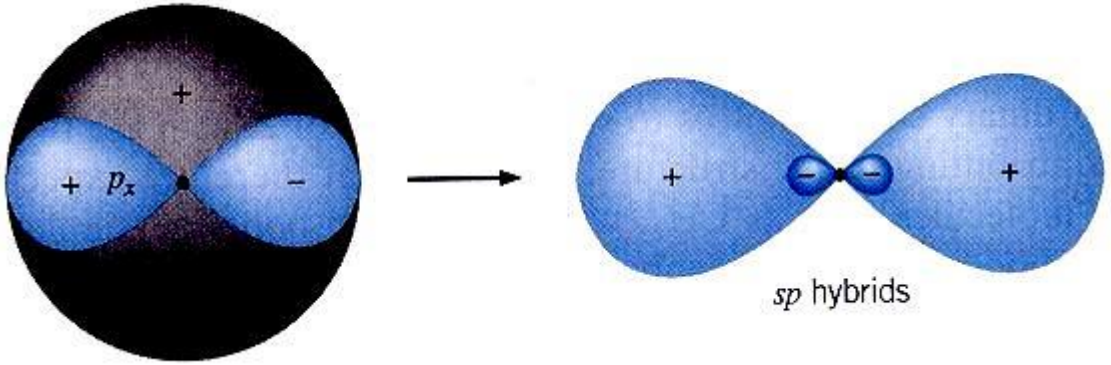
Hybridization

- The mixing of the native atomic orbitals to form special orbitals for bonding
- Number of hybrid orbitals formed is equal to the number of atomic orbitals mixed
- Three kinds:
  - sp^3
  - sp^2
  - sp

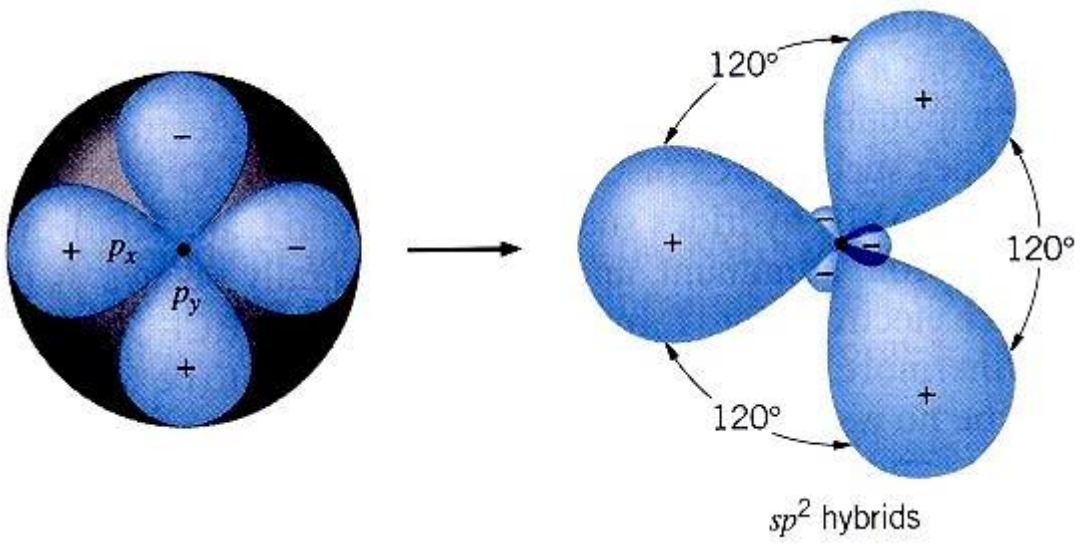
Hybrid Orbitals & Molecular Geometry

Hybrid Orbitals	Atomic Orbitals	Electron Geometry	Examples
sp	s, p	Linear	BeF_2, CO_2
sp^2	s, two p	Triangular planar	BF_3, SO_3
sp^3	s, three p	Tetrahedral	CH_4, NH_3, H_2O

sp Orbitals

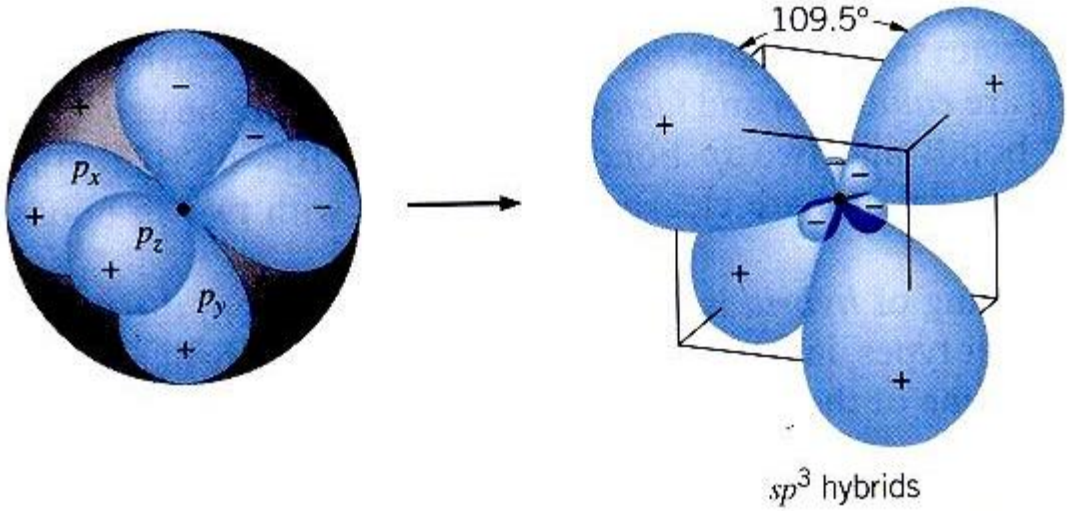


sp^2 Orbitals



sp^2 hybrids

sp^3 Orbitals



Sigma versus Pi Bonds

- Extra electrons pairs in a multiple bond are not located in the hybrid orbitals
- Sigma (σ) bond—electron pairs occupying a sigma bonding orbital
  - Hybridized orbitals
- Pi (π) bond—electron pairs occupying a pi bonding orbitals
  - Non-hybridized orbitals

Multiple Bonds

Type of Bond	# of Sigma Bonds	# of Pi Bonds	Example
Single	1	0	CH_4
Double	1	1	CO_2
Triple	1	2	N_2, CO